severity with which such causes prey upon them and their families.

In all such cases the great point which the manufacturer should endeavour to attain, when practicable, is the direct removal of noxious emanations from the very source at which they are developed. General ventilation must be superadded to give complete relief, but if noxious emanations be once permitted to escape into the atmosphere of the apartment or workshop, the entire change of atmosphere is essential to restore freshness to the air: whereas if every noxious product be treated as much as possible on the same principle as smoke, by providing arrangements for the direct exclusion of the products of combustion, a much less amount of ventilation is sufficient, and at the same time the ventilation becomes much more effectual.

Excepting sedentary occupations, where no peculiar noxious product is to be guarded against, the extreme variety of circumstances peculiar to each occupation in which noxious ingredients are communicated to the air in confined apartments, renders any general plan of operations impracticable beyond what has been indicated, without introducing an amount of interference that might be too prejudicial to the interests of the manufacturer to be generally supported.

The amount of suffering, however, and of early death under many circumstances, is so great, that any systematic means of fixing public attention on this subject, to such an extent as would explain the cause of death in factories where it is excessive, and the economy of sanatory measures, would be attended with very beneficial results, equally apparent both to the proprietor and the workman. To the former alone can we look for the general introduction of sanatory measures in their respective establishments; but more intelligence among the workmen is essential to enable them to appreciate and take full advantage of such opportunities as they may have.

As to the improvement of ventilation in crowded workshops occupied by tailors, milliners, shoemakers, and all persons engaged in sedentary occupations, where few or no deleterious products are evolved beyond those that arise from respiration and combustion, the question would be more justly stated were it described as a question of warming as well as one of ventilation, as it is rarely observed that there is any objection to the discharge of vitiated air when that which enters is adapted to the state of the system. Undoubtedly, a regular egress for the escape of vitiated air is seldom provided; but this can never be placed on a right footing, however much it may relieve distress, till the ingress of air, and the warmth it may be necessary to communicate, shall have been satisfactorily adjusted.

In no case do the evil effects of the imperfect distribution of air manifest themselves in a more palpable manner than where rooms are crowded with individuals engaged in sedentary occupations. An under-current passing along the surface of the floor to the fire-place in winter may occasion, on the whole, a considerable change of air, but its local movement deprives it of almost all its value. The fire may receive pure air, but little or none moves upwards to supply the organs of respiration.

The evils from defective ventilation are then of great magnitude, and the continuity of their operation gives them a power and influence over the system which cannot be too minutely investigated. Few pause to consider the necessary consequence of twenty respirations per minute, 1,200 per hour, or 28,800 in a single day and night, where not only a noxious atmosphere is inhaled, and brought directly in contact with the blood, but where also the state of the air diminishes the amount of discharge of those noxious products which the system discharges more and more largely, in proportion to the purity of atmosphere inspired.

Bad ventilation, also, is as injurious to the mind as to the body; and in its more aggravated forms not only induces headache and apoplexy, but, conjoined with other circumstances, is prone to favour that depression which leads at times to low spirits, or even to suicide.

If the progress of air be examined in a room of ancient date, where neither the doors nor windows are air-tight, an ingress of fresh air is almost invariably observed below, and an equivalent discharge of vitiated air above; the fire-place being in this case supposed to be inoperative and closed by an air-tight board. Stagnation is thus prevented, and a continuous, though subdued ventilation, maintained through the apartment, to an extent dependent on the magnitude of the crevices in the doors and windows, and the condition of the internal and external atmosphere.

Again, if the fire be in action in the same apartment, the air in general enters by all crevices to supply the draught it creates, so that in this manner also the freshness of the air is maintained. Farther, the great altitude of the open fire-place in ancient chimney-breasts sustains a very powerful circulation at a higher level than is commanded by low cottage-grates in modern rooms, when the feet may be bathed continuously in cold air, while the head is placed comparatively in a warm stagnant atmosphere, unless crevices in doors and windows permit a considerable change.

It is a matter of much regret that in many houses the supply of air is so perfectly inadequate, both for individual rooms and for passages, that they act continually upon each other, the powerful fire in one room overcoming the weaker draught in the other, and communicating through the passage, which is accordingly more or less filled with smoke, that is—carbonic acid gas, mingled with various visible impurities, particularly charcoal, oily, or other substances.

Vitiated air from lamps and candles, as well as from respiration, tends to ascend, though, as projected from the nostrils and the mouth, it moves, at first, more or less downwards, or in a horizontal direction. In experiments made on this subject, the temperature of air from different individuals placed in a box lined with cotton and open above and below, was found to be generally four degrees higher above the head than below the feet (the box was suspended in the air), and, at natural temperatures, a current constantly ascended on every side from the person. Thus then it is obvious, that, if the natural movements of vitiated air in ordinary apartments be facilitated by one opening at the lower part, and another above, every room will ventilate itself sufficiently to prevent the more extreme effects that are so often observed at present.

If the lower opening be diffused by extending it along the skirting, the current becomes more mild and equal and less liable to strike upon the person, so as to produce an offensive draught.

If the upper aperture be led into a chimney flue, or into an independent flue warmed by its near position to a hot chimney, its action is more powerful and more uniform than a mere aperture in the wall near the ceiling, and not so subject to modification in windy weather. If it communicate with a powerful chimney-flue, it works still better, except when the fire declines, or the supply of fresh air is interrupted, a dangerous recoil taking place, and the upper aperture discharging smoke into the apartment: this defect may be obviated to a great extent, though not entirely, by the use of valves, unless they be regulated, and adapted from time to time according to the varying circumstances of the case.

Two apertures, then, at different levels are the great essentials in each apartment, and so ample a supply to all stairs and passages, that they shall not borrow or draw down air from individual rooms, but give freely to all that do not draw their supply from an external source. The most serious evils from offensive draughts and currents may be greatly diminished by proper diffusion of the air, as well as by the previous communication of warmth to it. Diseases from exposure to draughts appear principally to arise when the constitution has been heated excessively, in consequence of a defective supply of air; but, were a small aperture left continually open, the constitution could never attain that extreme susceptibility of cold, and aversion to the slightest breath of air which so often accompanies too limited a supply, and that reduction of the insensible cutaneous and pulmonary exhalations by an atmosphere loaded with moisture which leaves the surface of the lungs and skin unduly excited and turgid with a load of material that would have been dissipated by exhalation and evaporation with a better supply of air.

When a fire-place is in action, it necessarily complicates the ventilation. But all cases of this kind resolve themselves into the following classes:

The first comprehends those in which the fire-flue alone becomes the discharge of vitiated air. This cannot be considered the best, as, under ordinary circumstances, the fresh air travels along the floor, and little rises to the head, where it is most largely required.

In the second class, the evil effects of the vitiated air, which is prone to accumulate above the chimney breast, are diminished by its being raised to a higher level than is now common, or by admitting the external air from an aperture above, near the ceiling, so as to sweep across the apartment in its descent to the fire-place.

In the third and best class, the chimney flue is reduced to a minimum, and carries off ably the products of combustion; another superior aperture discharging the products of respiration and of lamps and candles, while a free ingress of air prevents all interference of the fire-flue and the ventilating flues. This adjustment is carried still farther in some places by the union of the fire and ventilating flues, and by the provision of a sufficient local supply for the fire in its immediate vicinity, which reduces greatly the general force of the current throughout the apartment.

The above principles involve the more important bearings of the question of ventilation, so far as it affects the individual apartments in tenements occupied by the poorer classes of society, it being taken for granted that the evils arising from defective drainage, closets, and cleaning, and a bad external atmosphere, have been removed. Practically then, a well-constructed window, capable of being opened above and below, realizes, when the fire-place is well arranged, all the essentials for effective ventilation in such apartments. Windows, however, are not recommended as affording the best means of insuring ordinary ventilation, though they may be resorted to with advantage when the weather is not severe, or under peculiar circumstances, and should therefore always be available when large supplies of air are required; but for that more minute ventilation which the system requires and tolerates in the severity of the winter's cold, and at a time when the dryness of the air promotes rapid evaporation both from the skin and lungs, a much less extended opening is required, and one capable of more minute and delicate adjustment to the ever-varying circumstances of the case, than a window can be made to command. The complaints arising from draughts and currents exist only when the movement of air becomes excessive, and is not suited to the temperament on which it impinges. The human frame is so constituted that a movement of air is perpetually sustained around it by natural causes during life. Very cold air having a very gentle movement around the person may not be offensive, while a much warmer atmosphere moving rapidly may be productive of extreme annoyance.

Taking these circumstances into consideration, with the fact that doors and windows appear generally, if not universally, to have formed no barrier against the most defective ventilation, great improvements may be anticipated when every apartment shall be provided with an independent ingress for fresh air, and an egress for vitiated air, which, though small, shall be incessantly operating, much more capable of regulation, and one which can never induce those violent and extreme changes which are produced by the occasional opening of doors or windows that may have been closed for too long a period.

In the great majority of cases where any attempt at systematic ventilation has been carried into effect in ordinary apartments, the objections which have followed its introduction appear to have arisen principally from two causes, viz., the excessive introduction of fresh cold air, or its local movement arising from cold surfaces or defective diffusion, which might have been obviated by leading in the air at any more remote part of the room, or in any position, so as to admit of the first impulse being broken by a diffusion board, or by extending the aperture of ingress along the skirting.

Another cause which appears to have re-